IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Ramin Samadani   Art Unit   : 2624
Serial No. : 10/620,937   Examiner : Perungavoor, Sathyanaraya V
Filed   : July 16, 2003   Confirmation No.: 8859
Title   : High Resolution Image Reconstruction

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

I.   Real Party in Interest

The real party in interest is Hewlett-Packard Development Company, L.P., a Texas Limited Partnership having its principal place of business in Houston, Texas.

II.   Related Appeals and Interferences

Appellant is not aware of any related appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III.   Status of Claims

Claims 1-22 are pending.

Claims 7-9 and 16-18 would be allowable if rewritten in independent form including all the elements of the base claim and any intervening claims.

Claims 1-6, 10-15, and 19-22, which are the subject of this appeal, stand rejected.

Appellant appeals all rejections of the pending claims 1-6, 10-15, and 19-22.

IV.   Status of Amendments

The amendments filed June 28, 2008, have been entered and acted upon by the Examiner. No amendments were filed after the final Office action dated August 20, 2007.

V.   Summary of Claimed Subject Matter

A.   Independent claim 1

The aspect of the invention defined in independent claim 1 is a system for reconstructing a high resolution image ($\hat{A}_1$; see ¶ 16) from at least one image sequence (sequence 32; see ¶ 15; FIG. 3) of temporally related high and low resolution image frames, where each of the high resolution image frames (A_0, A_4, A_8) includes a low spatial frequency component (e.g., A_{OL}; see ¶ 17) and a high spatial frequency component (e.g., A_{OH}; see ¶ 17). The system includes a first spatial interpolator (see elements 38, 40 in FIG. 6) adapted to generate a low spatial frequency component (A_{1L}) from a low resolution image frame (a_1) of the at least one image sequence 32 (see ¶ 16; FIG. 8). The system also includes a high spatial frequency component generator (see elements 34, 36 in FIG. 4, and the adder in FIG. 7) for generating a high spatial frequency component (A_{OH}) from at least one high resolution image frame (A_0) of the at least one image sequence (32), where the at least one high resolution image frame (A_0) is closely related to the low resolution image frame (see ¶ 17; FIGS. 4 and 7). The system further includes a remapper (remap module 44; FIG. 9) for mapping the high spatial frequency component (A_{OH}) to a motion-compensated high spatial frequency component estimate ($\hat{A}'_{1H}$) of the low resolution image frame (a_1) (see ¶ 18; FIG. 9). The system additionally includes an adder (see adder in FIG. 12) for adding the motion-compensated high spatial frequency component estimate ($\hat{A}'_{1H}$) of the low resolution image frame (a_1) to the generated low spatial frequency component (A_{1L}) of the low

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resolution image frame (a_1) to form a reconstructed high resolution image ($\hat{A}_1$) of the low resolution image frame (a_1) (see ¶ 18; FIG. 12).

B. Dependent claim 2

Claim 2 depends from independent claim 1 and recites that the system further comprises a controller (see weights generator 46 in FIG. 10; ¶ 18) that controls relative contributions of said motion-compensated high spatial frequency component estimate ($\hat{A}'_{1H}$; see ¶ 18; FIG. 11) of said low resolution image frame (a_1) and said generated low spatial frequency component (A_{1L}) of said low resolution image frame (a_1) in the reconstructed high resolution image ($\hat{A}_1$) of said low resolution image frame (a_1) based on measures of confidence (CSF_{01}) in motion estimates (MVF_{01}; see FIG. 5; ¶17) used to map (see FIG. 9; ¶ 18) said high spatial frequency component (A_{0H}) to the motion-compensated high spatial frequency component estimate ($\hat{A}'_{1H}$) of said low resolution image frame (a_1; see FIG. 9; ¶ 18).

C. Dependent claim 6

Claim 6 depends from claim 1 and recites that the high spatial frequency component generator (see elements 34, 36 in FIG. 4, and the adder in FIG. 7) includes a downsampler (spatial subsampler 36 in FIG. 4; ¶ 17) for downsampling at least one high resolution image frame (e.g., A_0) of said at least one image sequence (sequence 32; see ¶ 15; FIG. 3).

D. Independent claim 10

The aspect of the invention defined in independent claim 10 is a method of reconstructing a high resolution image ($\hat{A}_1$; see ¶ 16) from at least one image sequence (sequence 32; see ¶ 15; FIG. 3) of temporally related high and low resolution image frames, where each of the high resolution image frames (A_0, A_4, A_8) includes a low spatial frequency component (e.g., A_{0L}; see ¶ 17) and a high spatial frequency component (e.g., A_{0H}; see ¶ 17). Spatially interpolating is performed (see elements 38, 40 in FIG. 6) to generate a low spatial frequency component (A_{1L}) from a low resolution image frame (a_1) of the at least one image sequence 32 (see ¶ 16; FIG. 8).

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A high spatial frequency component (A_{OH}) is generated (see elements 34, 36 in FIG. 4, and the adder in FIG. 7) from at least one high resolution image frame (A_0) of the at least one image sequence (32), where the at least one high resolution image frame (A_0) is closely related to the low resolution image frame (see ¶ 17; FIGS. 4 and 7). The high spatial frequency component (A_{OH}) is remapped (see remap module 44; FIG. 9) to a motion-compensated high spatial frequency component estimate ($\hat{A}'_{IH}$) of the low resolution image frame (a_1) (see ¶ 18; FIG. 9). The motion-compensated high spatial frequency component estimate ($\hat{A}'_{IH}$) of the low resolution image frame (a_1) is added (see adder in FIG. 12) to the generated low spatial frequency component (A_{IL}) of the low resolution image frame (a_1) to form a reconstructed high resolution image ($\hat{A}_1$) of the low resolution image frame (a_1) (see ¶ 18; FIG. 12).

E.   Dependent claim 11

Claim 11 depends from independent claim 10 and recites that the method further comprises controlling (see weights generator 46 in FIG. 10; ¶ 18) relative contributions of said motion-compensated high spatial frequency component estimate ($\hat{A}'_{IH}$; see ¶ 18; FIG. 11) of said low resolution image frame (a_1) and said generated low spatial frequency component (A_{IL}) of said low resolution image frame (a_1) in the reconstructed high resolution image ($\hat{A}_1$) of said low resolution image frame (a_1) based on measures of confidence (CSF_{01}) in motion estimates (MVF_{01}; see FIG. 5; ¶17) used to map (see FIG. 9; ¶ 18) said high spatial frequency component (A_{OH}) to the motion-compensated high spatial frequency component estimate ($\hat{A}'_{IH}$) of said low resolution image frame (a_1; see FIG. 9; ¶ 18).

F.   Dependent claim 15

Claim 15 depends from claim 10 and recites that the high spatial frequency component generating (see elements 34, 36 in FIG. 4, and the adder in FIG. 7) further comprises downsampling (see spatial subsampler 36 in FIG. 4; ¶ 17) at least one high resolution image frame (e.g., A_0)of said at least one image sequence (sequence 32; see ¶ 15; FIG. 3).

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G.   Independent claim 19

The aspect of the invention defined in independent claim 19 is a system for reconstructing a high resolution image ($\hat{A}_1$; see ¶ 16) from a mixed spatial resolution image sequence (sequence 32; see ¶ 15; FIG. 3) comprising temporally spaced-apart image frames having different respective spatial resolutions. The system includes a first frequency component generator (see elements 38, 40 in FIG. 6) that generates a first spatial frequency component (A_{1L}) from a first image frame (a_1) selected from the image sequence (sequence 32; see ¶ 16; FIG. 8), where the first image frame having a first spatial resolution. The system also includes a second frequency component generator (see elements 34, 36 in FIG. 4, and the adder in FIG. 7) that generates a second spatial frequency component (A_{0H}) from a second image frame (A_0) selected from the image sequence (sequence 32; see ¶ 16; FIG. 8), where the second image frame having a second spatial resolution higher than the first spatial resolution. The system further includes a remapper that spatially aligns the first and second spatial frequency components (A_{1L}, A_{0H}) based on estimates of motion (MVF_{01}; see FIG. 5; ¶17) between the first and second image frames (a_1, A_0). The system additionally includes a combiner (see adder in FIG. 12) that produces a high resolution image ($\hat{A}_1$) of the first image frame (a_1) from a combination of the spatially aligned first and second spatial frequency components (A_{1L}, A_{0H}; see ¶ 18; FIG. 12).

H.   Dependent claim 20

Claim 20 depends from claim 19 and recites that the combiner (see adder in FIG. 12) produces the high resolution image ($\hat{A}_1$) of the first image frame (a_1) from the spatially aligned first and second spatial frequency components (A_{1L}, A_{0H}) with relative contributions controlled by measures of confidence (CSF_{01}) in motion estimates (MVF_{01}; see FIGS. 5; ¶ 17) used to spatially align the first and second spatial frequency components (A_{1L}, A_{0H}).

I.   Dependent claim 21

Claim 21 depends from claim 20 and recites that the combiner (see adder in FIG. 12) produces the high resolution image ($\hat{A}_1$) of the first image frame (a_1) with relative contributions

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from the second frequency component (A_{OH}) that increase with increasing measures of confidence (CSF_{01}) in the associated motion estimates (MVF_{01}; see FIGS. 5; ¶ 17).

J.   Independent claim 22

The aspect of the invention defined in independent claim 22 is a method of reconstructing a high resolution image ($\hat{A}_1$; see ¶ 16) from a mixed spatial resolution image sequence (sequence 32; see ¶ 15; FIG. 3) comprising temporally spaced-apart image frames having different respective spatial resolutions. The method includes generating (see elements 38, 40 in FIG. 6) a first spatial frequency component (A_{1L}) from a first image frame (a_1) selected from the image sequence (sequence 32; see ¶ 16; FIG. 8), where the first image frame has a first spatial resolution. The method also includes generating (see elements 34, 36 in FIG. 4, and the adder in FIG. 7) a second spatial frequency component (A_{OH}) from a second image frame (A_0) selected from the image sequence (sequence 32; see ¶ 16; FIG. 8), the second image frame having a second spatial resolution higher than the first spatial resolution. The method further includes spatially aligning the first and second spatial frequency components (A_{1L}, A_{OH}) based on estimates of motion (MVF_{01}; see FIG. 5; ¶17) between the first and second image frames (a_1, A_0). The method additionally includes producing (see adder in FIG. 12) a high resolution image ($\hat{A}_1$) of the first image frame (a_1) from a combination of the spatially aligned first and second spatial frequency components (A_{1L}, A_{OH}; see ¶ 18; FIG. 12).

VI.   Grounds of Rejection to be Reviewed on Appeal

A.   Claims 2 and 11 stand rejected under 35 U.S.C § 112, first paragraph, "as failing to comply with the enablement requirement."

B.   Claims 2 and 11 stand rejected under 35 U.S.C § 112, second paragraph, "as being indefinite."

C.   Claims 1, 3, 4, 5, 10, 12-14, 19, and 22 stand rejected under 35 U.S.C. § 103(a) over Parke (U.S. 5,025,394) in view of Turner (U.S. 6,198,505).

D.   Claims 2, 11, 20, and 21 stand rejected under 35 U.S.C. § 103(a) over Parke (U.S. 5,025,394) in view of Turner (U.S. 6,198,505) and Burt (U.S. 5,649,032).

E.   Claims 6 and 15 stand rejected under 35 U.S.C. § 103(a) over Parke (U.S.

5,025,394) in view of Turner (U.S. 6,198,505) and Griessl (U.S. 6,370,196).

VII.   Argument

A.   Rejection of claims 2 and 11 under 35 U.S.C. § 112, first paragraph

Claims 2 and 11 stand rejected under 35 U.S.C § 112, first paragraph, "as failing to

comply with the enablement requirement."

1.   The examiner has failed to establish a *prima facie* case of nonenablement

As stated by the Federal Circuit:

> When rejecting a claim under the enablement requirement of
> Section 112, the [Patent Office] bears an initial burden of setting
> forth a reasonable explanation as to why it believes that the scope
> of protection provided by the claim is not adequately enabled by
> the description of the invention provided in the specification of the
> application; this includes, of course, providing sufficient reasons
> for doubting any assertions in the specification as to the scope of
> enablement.[1]

The only explanation given by the Examiner in support of the rejection of claims 2 and

11 under 35 U.S.C. § 112, first paragraph, is as follows (see page 3, § 3 of the final Office action;

original emphasis):

> Claims 2 and 11 are rejected under 35 U.S.C. 112, first paragraph,
> as failing to comply with the enablement requirement. The claim(s)
> contains subject matter which was not described in the
> specification in such a way as to enable one skilled in the art to
> which it pertains, or with which it is most neatly connected, to
> make and/or use the invention.
>
> • Examiner is unable to correlate the claim limitation to disclosure,
> hence does not see the invention as properly enabled in the
> disclosure. In response to this rejection, Examiner requests the
> applicant to <u>explicitly</u> map out each claim limitation, including the

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[1] *In re* Wright, 999 F.2d 1557, 27 USPQ 2d 1510, 1513 (Fed. Cir. 1993).

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claims upon which these claim depends upon, to the disclosure.
<u>Note, merely pointing out to pages or Paragraphs in the disclosure
in not sufficient, there needs to be an explicit correlation between
the claim language and the disclosure.</u>

Thus the sole basis for the Examiner's rejection of claims 2 and 11 under 35 U.S.C. §
112, first paragraph, is that he "is unable to correlate the claim limitation to disclosure, hence
does not see the invention as properly enabled in the disclosure." The Examiner, however, has
not provided a rational basis as to why the disclosure does not teach the manner and process of
making and using the inventive subject matter defined in claims 2 and 11 to one of ordinary skill
in the art, without undue experimentation, and dealing with subject matter that would not already
be known to the skilled person as of the filing date of the application.

For example, the Examiner has not explained in any way whatsoever why one skilled in
the art could not have made and used the inventive subject matter defined in claims 2 and 11
based on the disclosure provided in paragraph 18 and FIGS. 9-12. This disclosure describes a
weight function generator 46 that produces per-pixel weights that control how much of the high
spatial frequency component ($\hat{A}'_{1H}$) is added to the low spatial frequency component A_{1L} to form
the final reconstructed high spatial resolution image estimate ($\hat{A}_1$), where the values of the
weights are based on measures of confidence (CSF_{01}) in motion estimates (MVF_{01}; see FIG. 5;
¶17) used to map (see FIG. 9; ¶ 18) the high spatial frequency component (A_{0H}) to the motion-
compensated high spatial frequency component estimate ($\hat{A}'_{1H}$).

Instead of "setting forth a reasonable explanation as to why it believes that the scope of
protection provided by the claim is not adequately enabled by the description of the invention
provided in the specification of the application," the Examiner merely pointed to his inability "to
correlate the claim limitation to disclosure."

For at least this reason, the Examiner's rejection of claims 2 and 11 under 35 U.S.C. §
112, first paragraph, should be withdrawn.

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2.   In any event, claims 2 and 11 are enabled

The general rule is that the subject matter required to enable the invention need only be found in the application and/or the prior art for the application to be enabling under Section 112, first paragraph.

The following paragraph shows the "explicit correlation" between the disclosure and the elements of claim 2:

> Claim 2 depends from independent claim 1 and recites that the system further comprises a controller (see weights generator 46 in FIG. 10; ¶ 18) that controls relative contributions of said motion-compensated high spatial frequency component estimate ($\hat{A}'_{1H}$; see ¶ 18; FIG. 11) of said low resolution image frame (a_1) and said generated low spatial frequency component (A_{1L}) of said low resolution image frame (a_1) in the reconstructed high resolution image ($\hat{A}_1$) of said low resolution image frame (a_1) based on measures of confidence (CSF_{01}) in motion estimates (MVF_{01}; see FIG. 5; ¶17) used to map (see FIG. 9; ¶ 18) said high spatial frequency component (A_{0H}) to the motion-compensated high spatial frequency component estimate ($\hat{A}'_{1H}$) of said low resolution image frame (a_1; see FIG. 9; ¶ 18).

The following paragraph shows the "explicit correlation" between the disclosure and the elements of claim 11:

> Claim 11 depends from independent claim 10 and recites that the method further comprises controlling (see weights generator 46 in FIG. 10; ¶ 18) relative contributions of said motion-compensated high spatial frequency component estimate ($\hat{A}'_{1H}$; see ¶ 18; FIG. 11) of said low resolution image frame (a_1) and said generated low spatial frequency component (A_{1L}) of said low resolution image frame (a_1) in the reconstructed high resolution image ($\hat{A}_1$) of said low resolution image frame (a_1) based on measures of confidence (CSF_{01}) in motion estimates (MVF_{01}; see FIG. 5; ¶17) used to map (see FIG. 9; ¶ 18) said high spatial frequency component (A_{0H}) to the motion-compensated high spatial frequency component estimate ($\hat{A}'_{1H}$) of said low resolution image frame (a_1; see FIG. 9; ¶ 18).

Thus, the disclosure teaches the manner and process of making and using the inventive subject matter defined in claims 2 and 11 to one of ordinary skill in the art, without undue experimentation, and dealing with subject matter that would not already be known to the skilled person as of the filing date of the application.

For at least this additional reason, the Examiner's rejection of claims 2 and 11 under 35 U.S.C. § 112, first paragraph, should be withdrawn.

3.   Conclusion

For at least the reasons explained above, the Examiner's rejection of claims 2 and 11 under 35 U.S.C. § 112, first paragraph, should be withdrawn.

B.   Rejection of claims 2 and 11 under 35 U.S.C. § 112, second paragraph

Claims 2 and 11 stand rejected under 35 U.S.C § 112, second paragraph, "as being indefinite."

1.   The Standard for Establishing a *Prima Facie* Case of Indefiniteness under 35 U.S.C. § 112, Second Paragraph

Regarding the compliance of claims with 35 U.S.C. § 112, second paragraph, MPEP § 2173.02 explains that (citations omitted; original emphasis):

> The essential inquiry pertaining to this requirement is whether the claims set out and circumscribe a particular subject matter with a reasonable degree of clarity and particularity. Definiteness of claim language must be analyzed, not in a vacuum, but in light of:
>
> (A) The content of the particular application disclosure;
>
> (B) The teachings of the prior art; and
>
> (C) The claim interpretation that would be given by one possessing the ordinary level of skill in the pertinent art at the time the invention was made.
>
> In reviewing a claim for compliance with 35 U.S.C. 112, second paragraph, the examiner must consider the claim as a whole to determine whether the claim apprises one of ordinary skill in the

art of its scope and, therefore, serves the notice function required by 35 U.S.C. 112, second paragraph, by providing clear warning to others as to what constitutes infringement of the patent.

If the language of the claim is such that a person of ordinary skill in the art could not interpret the metes and bounds of the claim so as to understand how to avoid infringement, a rejection of the claim under 35 U.S.C. 112, second paragraph, would be appropriate. However, if the language used by applicant satisfies the statutory requirements of 35 U.S.C. 112, second paragraph, but the examiner merely wants the applicant to improve the clarity or precision of the language used, the claim must not be rejected under 35 U.S.C. 112, second paragraph, rather, the examiner should suggest improved language to the applicant.

The Examiner is obligated to establish a proper *prima facie* case of indefiniteness under 35 U.S.C. § 112, second paragraph. In this regard, the Board has stated that (emphasis added):

> In rejecting a claim under the second paragraph of 35 U.S.C. 112, it is incumbent on the examiner to establish that one of ordinary skill in the pertinent art, when reading the claims in light of the supporting specification, would not have been able to ascertain with a reasonable degree of precision and particularity the particular area set out and circumscribed by the claims.[2]

Similarly, MPEP § 2173.02 explains that (emphasis added):

> If upon review of a claim in its entirety, the examiner concludes that a rejection under 35 U.S.C. 112, second paragraph, is appropriate, such a rejection should be made and an analysis as to why the phrase(s) used in the claim is "vague and indefinite" should be included in the Office action.

2.   The Examiner's rejection under 35 U.S.C. § 112, second paragraph

The Examiner's only explanation for the rejection of claims 2 and 11 under 35 U.S.C. § 112, second paragraph, is as follows (see page 3, § 3 of the final Office action; original emphasis):

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[2] *Ex parte* Wu, 10 USPQ 2d 2031, 2033 (B.P.A.I. 1989) (emphasis added) (citing *In re* Moore, 439 F.2d 1232, 169 USPQ 236 (C.C.P.A. 1971)

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> Claims 2 and 11 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
>
> • Examiner is unable to correlate the claim limitation to disclosure, hence does not see the invention as properly enabled in the disclosure. In response to this rejection, Examiner requests the applicant to <u>explicitly</u> map out each claim limitation, including the claims upon which these claim depends upon, to the disclosure. <u>Note, merely pointing out to pages or Paragraphs in the disclosure in not sufficient, there needs to be an explicit correlation between the claim language and the disclosure.</u>

3.   The Examiner has not established a *prima facie* case of indefiniteness under 35 U.S.C. § 112, second paragraph

The entire basis for the Examiner's rejection of claims 2 and 11 is that he "is unable to correlate the claim limitation to disclosure." The Examiner, however, has not explained why one of ordinary skill in the pertinent art, when reading the claims in light of the supporting specification and the prior art, would not have been able to ascertain with a reasonable degree of precision and particularity the particular area set out and circumscribed by the claims.

Thus, the Examiner has not established a *prima facie* case of indefiniteness and therefore the rejection of claims 2 and 11 under 35 U.S.C. § 112, second paragraph, should be withdrawn for at least this reason.

4.   In any event, claims 2 and 11 are not indefinite

One of ordinary skill in the pertinent art, when reading claims 2 and 11 in light of the supporting specification, would have been able to ascertain with a reasonable degree of precision and particularity the particular area set out and circumscribed by the claims. Indeed, claims 2 and 11 are definite and apprise one skilled in the art of their respective scopes by providing clar warning to others as to what constitutes infringement of the claims.

Moreover, the sole basis for the Examiner's rejection of claims 2 and 11 (i.e., the Examiner's inability "to correlate the claim limitation to disclosure") is rendered moot in light of the following "explicit correlations" between the disclosure and the elements of claims 2 and 11:

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Claim 2 depends from independent claim 1 and recites that the system further comprises a controller (see weights generator 46 in FIG. 10; ¶ 18) that controls relative contributions of said motion-compensated high spatial frequency component estimate ($\hat{A}'_{1H}$; see ¶ 18; FIG. 11) of said low resolution image frame (a_1) and said generated low spatial frequency component (A_{1L}) of said low resolution image frame (a_1) in the reconstructed high resolution image ($\hat{A}_1$) of said low resolution image frame (a_1) based on measures of confidence (CSF_{01}) in motion estimates (MVF_{01}; see FIG. 5; ¶17) used to map (see FIG. 9; ¶ 18) said high spatial frequency component (A_{0H}) to the motion-compensated high spatial frequency component estimate ($\hat{A}'_{1H}$) of said low resolution image frame (a_1; see FIG. 9; ¶ 18).

Claim 11 depends from independent claim 10 and recites that the method further comprises controlling (see weights generator 46 in FIG. 10; ¶ 18) relative contributions of said motion-compensated high spatial frequency component estimate ($\hat{A}'_{1H}$; see ¶ 18; FIG. 11) of said low resolution image frame (a_1) and said generated low spatial frequency component (A_{1L}) of said low resolution image frame (a_1) in the reconstructed high resolution image ($\hat{A}_1$) of said low resolution image frame (a_1) based on measures of confidence (CSF_{01}) in motion estimates (MVF_{01}; see FIG. 5; ¶17) used to map (see FIG. 9; ¶ 18) said high spatial frequency component (A_{0H}) to the motion-compensated high spatial frequency component estimate ($\hat{A}'_{1H}$) of said low resolution image frame (a_1; see FIG. 9; ¶ 18).

For this additional reason, the rejection of claims 2 and 11 under 35 U.S.C. § 112, second paragraph, should be withdrawn.

4.   Conclusion

For the reasons explained above, the rejection of claims 2 and 11 under 35 U.S.C. § 112, second paragraph, should be withdrawn.

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C. Rejection of claims 1, 3, 4, 5, 10, 12-14, 19, and 22 under 35 U.S.C. § 103(a) over Parke in view of Turner

Claims 1, 3, 4, 5, 10, 12-14, 19, and 22 stand rejected under 35 U.S.C. § 103(a) over Parke (U.S. 5,025,394) in view of Turner (U.S. 6,198,505).

1. Applicable standards for sustaining a rejection under 35 U.S.C. § 103(a)

"A patent may not be obtained ... if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." 35 U.S.C. §103(a).

In an appeal involving a rejection under 35 U.S.C. § 103, an examiner bears the initial burden of establishing *prima facie* obviousness. See In re Rijckaert, 9 F.3d 1531, 1532, 28 USPQ2d 1955, 1956 (Fed. Cir. 1993). To support a *prima facie* conclusion of obviousness, the prior art must disclose or suggest all the limitations of the claimed invention.[3] See In re Lowry, 32 F.3d 1579, 1582, 32 USPQ2d 1 031, 1034 (Fed. Cir. 1994). If the examiner has established a *prima facie* case of obviousness, the burden of going forward then shifts to the applicant to overcome the *prima facie* case with argument and/or evidence. Obviousness, is then determined on the basis of the evidence as a whole and the relative persuasiveness of the arguments. This inquiry requires (a) determining the scope and contents of the prior art; (b) ascertaining the differences between the prior art and the claims in issue; (c) resolving the level of ordinary skill in the pertinent art; and (d) evaluating evidence of secondary consideration. See KSR Int'l Co. v. Teleflex Inc., No. 04-1350, slip op. at 2 (U.S. Apr. 30, 2007) (citing Graham v. John Deere, 383

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[3] The U.S. Patent and Trademark Office has set forth the following definition of the requirements for establishing a *prima facie* case of unpatentability (37 CFR § 1.56(b)(ii)):

> A *prima facie* case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

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U.S. I, 17-18, 148 USPQ 459, 467 (1966)). If all claim limitations are found in a number of prior art references, the fact finder must determine whether there was an apparent reason to combine the known elements in the fashion claimed. See KSR, slip op. at 14. This analysis should be made explicit. KSR, slip op at 14 (citing In re Kahn, 441 F. 3d 977, 988 (CA Fed. 2006): "[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness").

2.   Independent claim 1

a.   Introduction

Independent claim 1 recites:

> 1.   A system for reconstructing a high resolution image from at least one image sequence of temporally related high and low resolution image frames, each of said high resolution image frames including a low spatial frequency component and a high spatial frequency component, said system comprising:
>
> a first spatial interpolator adapted to generate a low spatial frequency component from a low resolution image frame of said at least one image sequence;
>
> a high spatial frequency component generator for generating a high spatial frequency component from at least one high resolution image frame of said at least one image sequence, said at least one high resolution image frame being closely related to said low resolution image frame;
>
> a remapper for mapping said high spatial frequency component to a motion-compensated high spatial frequency component estimate of said low resolution image frame; and
>
> an adder for adding said motion-compensated high spatial frequency component estimate of said low resolution image frame to said generated low spatial frequency component of said low resolution image frame to form a reconstructed high resolution image of said low resolution image frame.

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As explained in detail below, the rejection of independent claim 1 under 35 U.S.C. § 103(a) over Parke in view of Turner should be withdrawn because (1) the Examiner has not shown that the cited references disclose each and every element of the claim, and (2) one skilled in the art at the time the invention was made would not have had any apparent reason to modify the teachings of Parke and Turner in the in a way that would arrive at the inventive subject matter defined by the claim.

b.   The Examiner's position

In the final Office action, the Examiner explained the basis for his rejection of claims 1, 3-5, 10, 12-14, 19, and 22 as follows (see page 4, § 5 of the final Office action):

> Claims 1, 3,4, 5, 10, 12, 13, 14, 19 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Parke in view of Turner et al. ("Turner"), as set forth in the previous non-final office action (mailed on 03/28/2007), which is incorporated herein by reference.

In the first Office action dated March 28, 2007, the Examiner gave the following reasoning in support of the rejection of claim 1 over Parke in view of Turner (see page 4, § 5 of the first Office action; underlining added; strikeout in original):

> Regarding claim 1, Parke discloses the following claim limitations:
>
> A system for reconstructing a high resolution image (i.e. high resolution output) from at least one image sequence of temporally related high (i.e. 220) and low (i.e. 210) resolution image frames, each of said high resolution image frames including a low spatial frequency component and a high spatial frequency component [fig. 2; col. 5, ll. 5-10}, said system comprising: a [first spatial interpolator] adapted to generate a low spatial frequency (i.e. 211) component from a low resolution image frame (i.e. 210) of said at least one image sequence [fig. 2; col. 4, ll. 47-61]; a [high spatial frequency component generator] for generating a high spatial frequency (i.e. 221) component from at least one high resolution image frame (i.e. 220) of said at least one image sequence, said at least one high resolution image frame being closely related to said low resolution image frame [fig. 2, col. 5, ll. 1-10]; an [adder] (i.e. 230) for adding said ~~motion compensated~~ high spatial frequency component estimate (i.e. temporally interpolated high resolution

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frames, which have been high pass filtered) of said low resolution image frame to said generated low spatial frequency component (i.e. spatially interpolated low resolution images, which have been low pass filtered) of said low resolution image frame to form a reconstructed high resolution image (i.e. high resolution output) of said low resolution image frame [fig. 2; col. 6, ll. 40-55].

Parke does not explicitly disclose the following claim limitations (emphasis added):

> a [remapper] for mapping said high spatial frequency component to a motion-compensated high spatial frequency component estimate of said low resolution image frame; and

However, in the same field of endeavor Turner discloses the deficient claim limitations, as follows:

> A remapper for mapping a high resolution image to generate a motion-compensated (i.e. move pixels based on motion vector) high resolution image [col. 4, ll. 60-67; col. 5, ll. 14-23].

It would have been obvious to one with ordinary skill in the art at the time of invention to modify Parke's temporal interpolation to include motion compensation as taught by Turner's temporal interpolation, the motivation being to generate images of a moving scene [col. 1, ll. 56-60).

Thus, the Examiner's rejection of claim 1 is premised on the assertion that:

- Parke discloses

  - the first spatial interpolator element of claim 1 in fig. 2, col. 4, lines 47-61,

  - the high spatial frequency component generator element of claim 1 in fig. 2, col. 5, lines 1-10, and

  - the adder element of claim 1 in fig. 2; col. 6, lines 40-55;

- Parke does not disclose the remapper element of claim 1; and

- Turner makes-up for the failure of Parke to disclose the remapper element of claim 1 in col. 4, lines 60-67; col. 5, lines 14-23.

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c.   <u>Appellant's rebuttal: the cited references do not disclose each and every element of claim 1</u>

Contrary to the Examiner's statement, Parke does not disclose "a first spatial interpolator adapted to generate a low spatial frequency component <u>from a low resolution image frame</u> of said at least one image sequence" and "a high spatial frequency component generator for generating a high spatial frequency component <u>from at least one high resolution image frame</u> of said at least one image sequence" (emphasis added). In particular, Parke teaches that the low resolution frames and the high resolution frames are produced <u>from the same set of high resolution video frames</u> (see col. 4, lines 13-42, especially lines 35-38; FIG. 2). One skilled in the art at the time the invention was made would have understood from Parke's reference to the video frames as "high resolution video" (see col. 4, line 38) that these video frames have the same (i.e., high) spatial resolution.

Turner does not make-up for the failure of Parke to disclose "a first spatial interpolator adapted to generate a low spatial frequency component from a low resolution image frame of said at least one image sequence" and "a high spatial frequency component generator for generating a high spatial frequency component from at least one high resolution image frame of said at least one image sequence." Indeed, Turner's camera does not generate low spatial frequency components from the motion frames that are output from the high speed imager 34; Turner's camera simply processes the motion frames to produce motion vector fields that are used for predicting the intermediate frames that are interpolated between two successive truth frames (see col. 3, lines 61-64, col. 4, lines 25-38, and col. 4, lines 60-67). Turner's camera also does not generate high spatial frequency components from the high resolution truth frames; instead, Turner's camera simply interpolates between successive truth frames to produce the intermediate frames (see col. 3, lines 61-64, col. 4, lines 25-38, and col. 4, lines 60-67).

Thus, the proposed combination of Parke and Turner does not disclose or suggest all the limitations of the claimed invention. For at least this reason, the rejection of independent claim 1 under 35 U.S.C. § 103(a) should be withdrawn.

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The Examiner has given only the following response to these points: "Examiner refers the applicant to the rejection where limitations are glaringly mapped out" (page 2, § 2 of the final Office action).

> ### d. Appellant's rebuttal: one skilled in the art at the time the invention was made would not have had any apparent reason to modify the teachings of Turek in the manner proposed by the Examiner

The Examiner has acknowledged that Parke does not disclose "a remapper for mapping said high spatial frequency component to a motion-compensated high spatial frequency component estimate of said low resolution image frame," as recited in claim 1. The Examiner has relied on Turner in an effort to make-up for this failure of Parke's teachings. In particular, the Examiner has stated that:

> However, in the same field of endeavor Turner discloses the deficient claim limitations, as follows:
>
>> A remapper for mapping a high resolution image to generate a motion-compensated (i.e. move pixels based on motion vector) high resolution image [col. 4, ll. 60-67; col. 5, ll. 14-23].
>
> It would have been obvious to one with ordinary skill in the art at the time of invention to modify Parke's temporal interpolation to include motion compensation as taught by Turner's temporal interpolation, the motivation being to generate images of a moving scene [col. 1, ll. 56-60).

Contrary to the Examiner's statement, however, one skilled in the art at the time the invention was made would not have had any apparent reason to combine the teachings of Parke and Turner in the proposed manner. The reason Parke fails to teach or suggest anything about "a remapper for mapping said high spatial frequency component to a motion-compensated high spatial frequency component estimate of said low resolution image frame" is not surprising because the low resolution frames and the high resolution frames that are computed in blocks 210 and 220, respectively, already are aligned spatially. In particular, as shown in FIG. 3, each of the high resolution images is computed from the same image data that is used to compute a corresponding one of the low resolution image frames (see, e.g., col. 6, lines 15-40; FIG. 3, steps

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321, 322, 330, and 350). Consequently, the high resolution images (including the interpolated high resolution images described in col. 6, lines 48-52) and corresponding ones of the low resolution images necessarily are aligned spatially; there is no motion to be compensated. Thus, one skilled in the art at the time the invention was made would not have had any apparent reason to combine the teachings of Parke and Turner in the manner proposed by the Examiner because such a modification of Parke's teachings would not have served any useful purpose whatsoever.

For at least this additional reason, the rejection of claim 1 under 35 U.S.C. § 103(a) over Parke and Turner should be withdrawn.

The Examiner did not reply to this point in the final Office action.

e. Conclusion

For the reasons explained above, the rejection of claim 1 under 35 U.S.C. § 103(a) over Parke in view of Turner should be withdrawn.

3. Claims 3-5

Each of claims 3-5 incorporates the features of independent claim 1 and therefore is patentable over Parke and Turner for at least the same reasons explained above.

4. Claim 10

Independent claim 10 recites

> 10. A method of reconstructing a high-resolution image from at least one image sequence of temporally related high and low resolution image frames, each of said high-resolution image frames including a low spatial frequency component and a high spatial frequency component comprising:
>
> spatially interpolating to generate a low spatial frequency component from a low-resolution image frame of said at least one image sequence;
>
> generating a high spatial frequency component from at least one high resolution image frame of said at least one image sequence, said at least one high resolution image frame being closely related to said low resolution image frame;

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> remapping said high spatial frequency component to a
> motion-compensated high spatial frequency component estimate of
> said low resolution image frame; and

> adding said motion-compensated high spatial frequency
> component estimate of said low resolution image frame to said
> generated low spatial frequency component of said low resolution
> image frame to form a reconstructed high resolution image of said
> low resolution image frame.

Independent claim 10 recites elements that essentially track the pertinent elements of claim 1 discussed above. Therefore, claim 10 is patentable over Parke and Turner for at least the same reasons explained above in connection with claim 1. In particular, the rejection of independent claim 10 under 35 U.S.C. § 103(a) over Parke in view of Turner should be withdrawn because (1) the Examiner has not shown that the cited references disclose the interpolating, generating, and remapping elements of claim 10, and (2) one skilled in the art at the time the invention was made would not have had any apparent reason to modify the teachings of Parke and Turner to arrive at the invention defined in independent claim 10.

5. Claim 12-14

Each of claims 12-14 incorporates the features of independent claim 10 and therefore is patentable over Parke and Turner for at least the same reasons explained above.

6. Claim 19

In the final Office action, the Examiner has stated that (see page 4, § 5 of the final Office action):

> Claims 1, 3,4, 5, 10, 12, 13, 14, 19 and 22 are rejected under 35
> U.S.C. 103(a) as being unpatentable over Parke in view of Turner
> et al. ("Turner"), as set forth in the previous non-final office action
> (mailed on 03/28/2007), which is incorporated herein by reference.

In the first Office action dated March 28, 2007, however, the Examiner did not set forth any reason whatsoever in support of the rejection of the rejection of claim 19. Thus, the Examiner has not established a *prima facie* basis that supports the rejection of claim 19 under 35

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U.S.C. § 103(a) over Parke in view of Tuner (see <u>KSR Int'l Co. v. Teleflex Inc.</u>, slip op at 14, citing <u>In re Kahn</u>, 441 F. 3d 977, 988 (CA Fed. 2006): "[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness").

For at least this reason, the rejection of claim 19 under 35 U.S.C. § 103(a) over Parke in view of Turner should be withdrawn.

The rejection of claim 19 under 35 U.S.C. § 103(a) over Parke in view of Turner also should be withdrawn for the following additional reasons.

Independent claim 19 recites:

> 19. A system for reconstructing a high resolution image from a mixed spatial resolution image sequence comprising temporally spaced-apart image frames having different respective spatial resolutions, the system comprising:
>
> a first frequency component generator that generates a first spatial frequency component from a first image frame selected from the image sequence, the first image frame having a first spatial resolution;
>
> a second frequency component generator that generates a second spatial frequency component from a second image frame selected from the image sequence, the second image frame having a second spatial resolution higher than the first spatial resolution;
>
> a remapper that spatially aligns the first and second spatial frequency components based on estimates of motion between the first and second image frames; and
>
> a combiner that produces a high resolution image of the first image frame from a combination of the spatially aligned first and second spatial frequency components.

Parke does not disclose "a first frequency component generator that generates a first spatial frequency component from a first image frame selected from the image sequence, the first image frame having a first spatial resolution" and "a second frequency component generator that generates a second spatial frequency component from a second image frame selected from the image sequence, the second image frame having a second spatial resolution higher than the first spatial resolution." Instead, Parke teaches that the low resolution frames and the high resolution

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frames are produced from the same set of high resolution video frames (see col. 4, lines 13-42, especially lines 35-38; FIG. 2). One skilled in the art at the time the invention was made would have understood from Parke's reference to the video frames as "high resolution video" (see col. 4, line 38) that these video frames have the same (i.e., high) spatial resolution.

Turner does not make-up for the failure of Parke to disclose the first and second frequency component generator elements of claim 19. Indeed, Turner's camera does not generate low spatial frequency components from the motion frames that are output from the high speed imager 34; Turner's camera simply processes the motion frames to produce motion vector fields that are used for predicting the intermediate frames that are interpolated between two successive truth frames (see col. 3, lines 61-64, col. 4, lines 25-38, and col. 4, lines 60-67). Turner's camera also does not generate high spatial frequency components from the high resolution truth frames; instead, Turner's camera simply interpolates between successive truth frames to produce the intermediate frames (see col. 3, lines 61-64, col. 4, lines 25-38, and col. 4, lines 60-67).

Thus, the proposed combination of Parke and Turner does not disclose or suggest all the limitations of the claimed invention. For at least this reason, the rejection of independent claim 19 under 35 U.S.C. § 103(a) should be withdrawn.

In addition, for the same reasons acknowledged by the Examiner regarding Parke's failure to disclose or suggest the remapper element of claim 1, Parke also fails to disclose or suggest "a remapper that spatially aligns the first and second spatial frequency components based on estimates of motion between the first and second image frames," as recited in claim 19. As explained above in connection with independent claim 1. One skilled in the art at the time the invention was made would not have had any apparent reason to combine the teachings of Parke and Turner. The reason Parke fails to teach or suggest anything about "a remapper for mapping said high spatial frequency component to a motion-compensated high spatial frequency component estimate of said low resolution image frame" is not surprising because the low resolution frames and the high resolution frames that are computed in blocks 210 and 220, respectively, already are aligned spatially. In particular, as shown in FIG. 3, each of the high resolution images is computed from the same image data that is used to compute a corresponding one of the low resolution image frames (see, e.g., col. 6, lines 15-40; FIG. 3, steps 321, 322, 330,

and 350). Consequently, the high resolution images (including the interpolated high resolution images described in col. 6, lines 48-52) and corresponding ones of the low resolution images necessarily are aligned spatially; there is no motion to be compensated. Thus, one skilled in the art at the time the invention was made would not have had any apparent reason to combine the teachings of Parke and Turner in the manner proposed by the Examiner because such a modification of Parke's teachings would not have served any useful purpose whatsoever.

For at least this additional reason, the rejection of claim 19 under 35 U.S.C. § 103(a) over Parke and Turner should be withdrawn.

7.   Claim 22

Independent claim 22 recites

22.   A method of reconstructing a high resolution image from a mixed spatial resolution image sequence comprising temporally spaced-apart image frames having different respective spatial resolutions, the method comprising:

generating a first spatial frequency component from a first image frame selected from the image sequence, the first image frame having a first spatial resolution;

generating a second spatial frequency component from a second image frame selected from the image sequence, the second image frame having a second spatial resolution higher than the first spatial resolution;

spatially aligning the first and second spatial frequency components based on estimates of motion between the first and second image frames; and

producing a high resolution image of the first image frame from a combination of the spatially aligned first and second spatial frequency components.

Independent claim 22 recites elements that essentially track the pertinent elements of claim 19 discussed above. Therefore, claim 22 is patentable over Parke and Turner for at least the same reasons explained above in connection with claim 19. In particular, the rejection of independent claim 22 under 35 U.S.C. § 103(a) over Parke in view of Turner should be

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withdrawn because (1) the Examiner has not shown that the cited references disclose the generating and remapping elements of claim 22, and (2) one skilled in the art at the time the invention was made would not have had any apparent reason to modify the teachings of Parke and Turner to arrive at the invention defined in claim 22.

D. Rejection of claims 2, 11, 20, and 21 under 35 U.S.C. § 103(a) over Parke in view of Turner and Burt

Claims 2, 11, 20, and 21 stand rejected under 35 U.S.C. § 103(a) over Parke (U.S. 5,025,394) in view of Turner (U.S. 6,198,505) and Burt (U.S. 5,649,032).

1.   Claim 2

Claim 2 incorporates the elements of independent claim 1. Burt does not make-up for the failure of Parke and Turner to teach or suggest the features of independent claim 1 discussed above. Therefore, claim 2 is patentable over Parke, Turner, and Burt for at least the same reasons explained above in connection with claim 1.

For at least this reason, the rejection of claim 2 under 35 U.S.C. § 103(a) over Parke in view of Turner and Burt should be withdrawn.

Claim 2 also is patentable over Parke in view of Turner and Burt for the following additional reasons.

Claim 2 recites:

> 2.   The high resolution image reconstruction system of claim 1, further comprising a controller that controls relative contributions of said motion-compensated high spatial frequency component estimate of said low resolution image frame and said generated low spatial frequency component of said low resolution image frame in the reconstructed high resolution image of said low resolution image frame based on measures of confidence in motion estimates used to map said high spatial frequency component to the motion-compensated high spatial frequency component estimate of said low resolution image frame.

The Examiner has acknowledged that Parke and Turner do not disclose the elements of claim 2 (see page 4, § 6 of the final Office action). The Examiner has relied on Burt to make-up

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for the failure of Parke and Turner to disclose or suggest the elements of claim 2. In particular,

the Examiner has stated that (see page 5, § 2 of the final Office action):

> However, in the same field of endeavor Burt discloses the deficient
> Claim limitations, as follows:
>
> A controller controlling (i.e. through alignment parameters) the
> adding (i.e. fusion) of input image and the mosaic to optimize
> motion confidence [col. 10, ll. 16-23; col. 11, ll. 45-50].
>
> It would have been obvious to one with ordinary skill in the art at
> the time of invention to modify the teachings of Parke and Turner
> with Burt to apply weighted the alignment parameters according to
> motion confidence values, the motivation being remove influence
> of erred motion vectors [col. 10, ll. 16-23).

On its face, the rationale give by the Examiner in support of the rejection of claim 2 does

not establish a *prima facie* case of obviousness. In particular, claim 2 does not recite

"controlling ... the adding ... of input image and the mosaic to optimize motion confidence," as

assumed by the Examiner. Instead, claim 2 recites "a controller that controls relative

contributions of said motion-compensated high spatial frequency component estimate of said low

resolution image frame and said generated low spatial frequency component of said low

resolution image frame in the reconstructed high resolution image of said low resolution image

frame based on measures of confidence in motion estimates used to map said high spatial

frequency component to the motion-compensated high spatial frequency component estimate of

said low resolution image frame" (emphasis added). The "input image" and the "mosaic" cited

by the Examiner do not constitute any of a motion-compensated high spatial frequency

component estimate of a low resolution image frame and a low spatial frequency component of

the low resolution image frame. Instead, the both the input image and the mosaic are full images

containing all frequency components. In addition, "controlling ... to optimize motion

confidence", as stated by the Examiner, does not constitute controlling relative contributions of a

motion-compensated high spatial frequency component estimate of a low resolution image frame

and a low spatial frequency component of the low resolution image frame in a reconstructed high

resolution image of the low resolution image frame. Therefore, the Examiner has not shown that

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Burt makes-up for the failure of Parke and Turner to disclose or suggest each and every one of the elements of claim 2.

Moreover, the cited sections of Burt (i.e., col. 10, lines 16-23 and col. 11, lines 45-50) do not make-up for the failure of Parke and Turner to disclose or suggest the elements of claim 2. In particular, in col. 10, lines 16-23, Burt merely discloses that a regression is used to fit a flow field to a motion model, where vector confidence values are used to weigh each vector's influence to the regression. In col. 11, lines 45-50, Burt mere discloses that an image fusion technique is used to combine the mosaic and the input image. Neither of these cited sections of Burt's disclosure has anything whatsoever to do with controlling relative contributions of a motion-compensated high spatial frequency component estimate of a low resolution image frame and a low spatial frequency component of the low resolution image frame in a reconstructed high resolution image of the low resolution image frame, as recited in claim 2.

For at least these additional reasons, the rejection of claim 2 under 35 U.S.C. § 103(a) over Parke in view of Turner and Burt should be withdrawn.

2.   Claim 11

Claim 11 incorporates the elements of independent claim 10. Burt does not make-up for the failure of Parke and Turner to teach or suggest the elements of independent claim 10 discussed above. Therefore, claim 11 is patentable over Parke, Turner, and Burt for at least the same reasons explained above in connection with claim 10.

Claim 11 recites elements that essentially tracks the pertinent element of claim 2 discussed above. Therefore, claim 11 is patentable over Parke in view of Turner and Burt for at least the same reasons explained above in connection with claim 2.

3.   Claim 20

Claim 20 incorporates the elements of independent claim 19. Burt does not make-up for the failure of Parke and Turner to teach or suggest the elements of independent claim 19 discussed above. Therefore, claim 20 is patentable over Parke, Turner, and Burt for at least the same reasons explained above in connection with claim 19.

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Claim 20 also is patentable over Parke in view of Turner and Burt for the following additional reason.

Claim 20 recites that "the combiner produces the high resolution image of the first image frame from the spatially aligned first and second spatial frequency components with relative contributions controlled by measures of confidence in motion estimates used to spatially align the first and second spatial frequency components." For reasons analogous to those reasons explained above in connection with claim 2, neither Parke nor Turner nor Burt discloses or suggests producing a high resolution image of the first image frame from spatially aligned first and second spatial frequency components with relative contributions controlled by measures of confidence in motion estimates used to spatially align the first and second spatial frequency components, as recited in claim 20. Since the cited references fail to disclose each and every one of the elements of claim 20, the rejection of claim 20 under 35 U.S.C. § 103(a) over Parke in view of Turner and Burt should be withdrawn.

4.   Claim 21

Claim 21 incorporates the elements of independent claim 20. Burt does not make-up for the failure of Parke and Turner to teach or suggest the elements of independent claim 20 discussed above. Therefore, claim 21 is patentable over Parke, Turner, and Burt for at least the same reasons explained above in connection with claim 21.

Claim 20 also is patentable over Parke in view of Turner and Burt for the following additional reason.

Claim 21 recites that "the combiner produces the high resolution image of the first image frame with relative contributions from the second frequency component that increase with increasing measures of confidence in the associated motion estimates."

In support of the rejection of claim 21, the Examiner merely stated that "Regarding claims 11, 20 and 21, all claimed limitations are set forth and rejected as per discussion for claim 2." The rationale given by the Examiner in support of the rejection of claim 2, however, does not address any of the elements of claim 21. In particular, the rationale given in support of the rejection of claim 2 does not show that Burt discloses that the relative contributions from the

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second frequency component increase with increasing measures of confidence in the associated motion estimates. Therefore, the Examiner has not shown that the cited references disclose each and every element of claim 21 and the rejection must be withdrawn.

E. Rejection of claims 6 and 15 under 35 U.S.C. § 103(a) over Parke in view of Turner and Griessl

Claims 6 and 15 stand rejected under 35 U.S.C. § 103(a) over Parke (U.S. 5,025,394) in view of Turner (U.S. 6,198,505) and Griessl (U.S. 6,370,196).

1. Claim 6

Claim 6 incorporates the elements of independent claim 1. Griessl does not make-up for the failure of Parke and Turner to teach or suggest the elements of independent claim 1 discussed above. Therefore, claim 6 is patentable over Parke, Turner, and Griessl for at least the same reasons explained above in connection with claim 1.

For at least this reason, the rejection of claim 6 under 35 U.S.C. § 103(a) over Parke in view of Turner and Griessl should be withdrawn.

2. Claim 15

Claim 15 incorporates the elements of independent claim 10. Griessl does not make-up for the failure of Parke and Turner to teach or suggest the elements of independent claim 10 discussed above. Therefore, claim 15 is patentable over Parke, Turner, and Griessl for at least the same reasons explained above in connection with claim 10.

VIII. Conclusion

For the reasons explained above, all of the pending claims are now in condition for allowance and should be allowed.

Charge any excess fees or apply any credits to Deposit Account No. 08-2025.

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Respectfully submitted,

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CLAIMS APPENDIX

The claims that are the subject of Appeal are presented below.

Claim 1 (original): A system for reconstructing a high resolution image from at least one image sequence of temporally related high and low resolution image frames, each of said high resolution image frames including a low spatial frequency component and a high spatial frequency component, said system comprising:

a first spatial interpolator adapted to generate a low spatial frequency component from a low resolution image frame of said at least one image sequence;

a high spatial frequency component generator for generating a high spatial frequency component from at least one high resolution image frame of said at least one image sequence, said at least one high resolution image frame being closely related to said low resolution image frame;

a remapper for mapping said high spatial frequency component to a motion-compensated high spatial frequency component estimate of said low resolution image frame; and

an adder for adding said motion-compensated high spatial frequency component estimate of said low resolution image frame to said generated low spatial frequency component of said low resolution image frame to form a reconstructed high resolution image of said low resolution image frame.

Claim 2 (previously presented): The high resolution image reconstruction system of claim 1, further comprising a controller that controls relative contributions of said motion-compensated high spatial frequency component estimate of said low resolution image frame and said generated low spatial frequency component of said low resolution image frame in the reconstructed high resolution image of said low resolution image frame based on measures of confidence in motion estimates used to map said high spatial frequency component to the motion-compensated high spatial frequency component estimate of said low resolution image frame.

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Claim 3 (previously presented): The high resolution image reconstruction system of claim 1, wherein said first spatial interpolator upsamples the low resolution image frame in accordance with a bicubic upsampling algorithm.

Claim 4 (previously presented): The high resolution image reconstruction system of claim 1, wherein said first spatial interpolator upsamples the low resolution image frame in accordance with a bilinear upsampling algorithm.

Claim 5 (previously presented): The high resolution image reconstruction system of claim 1, wherein said first spatial interpolator upsamples the low resolution image frame in accordance with a least squares error minimization algorithm.

Claim 6 (original): The high resolution image reconstruction system of claim 1, wherein said high spatial frequency component generator includes a downsampler for downsampling at least one high resolution image frame of said at least one image sequence.

Claim 7 (original): The high resolution image reconstruction system of claim 6, wherein said high spatial frequency component generator further includes a subpixel motion processor for generating a motion vector field and a confidence scalar field from said downsampled high resolution image frame and said low resolution image frame of said at least one image sequence.

Claim 8 (original): The high resolution image reconstruction system of claim 7, wherein said high spatial frequency component generator further includes a second spatial interpolator adapted to generate a low spatial frequency component from said downsampled high resolution image frame.

Claim 9 (original): The high resolution image reconstruction system of claim 8, wherein said high spatial frequency component generator further includes a subtractor for subtracting said generated low spatial frequency component from said at least one high resolution image frame of

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said at least one image sequence to obtain a high spatial frequency component of said at least one high resolution image frame of said at least one image sequence.

Claim 10 (original): A method of reconstructing a high-resolution image from at least one image sequence of temporally related high and low resolution image frames, each of said high-resolution image frames including a low spatial frequency component and a high spatial frequency component comprising:

spatially interpolating to generate a low spatial frequency component from a low-resolution image frame of said at least one image sequence;

generating a high spatial frequency component from at least one high resolution image frame of said at least one image sequence, said at least one high resolution image frame being closely related to said low resolution image frame;

remapping said high spatial frequency component to a motion-compensated high spatial frequency component estimate of said low resolution image frame; and

adding said motion-compensated high spatial frequency component estimate of said low resolution image frame to said generated low spatial frequency component of said low resolution image frame to form a reconstructed high resolution image of said low resolution image frame.

Claim 11 (previously presented): The method of claim 10, further comprising controlling relative contributions of said motion-compensated high spatial frequency component estimate of said low resolution image frame and said generated low spatial frequency component of said low resolution image frame in the reconstructed high resolution image of said low resolution image frame based on measures of confidence in motion estimates used to map said high spatial frequency component to the motion-compensated high spatial frequency component estimate of said low resolution image frame.

Claim 12 (original): The method of claim 10, wherein said spatially interpolating is performed by bicubic upsampling.

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Claim 13 (original): The method of claim 10, wherein said spatially interpolating is performed by bilinear upsampling algorithm.

Claim 14 (original): The method of claim 10, wherein said spatially interpolating is performed by utilizes a least squares error minimization algorithm.

Claim 15 (original): The method of claim 10, wherein said high spatial frequency component generating further comprises downsampling at least one high resolution image frame of said at least one image sequence.

Claim 16 (original): The method of claim 15, wherein said high spatial frequency component generating further comprises subpixel motion processing for the purpose of generating a motion vector field and a confidence scalar field from said downsampled high resolution image frame and said low resolution image frame of said at least one image sequence.

Claim 17 (original): The method of claim 16, wherein said high spatial frequency component generating further comprises spatially interpolating to generate a low spatial frequency component from said downsampled high-resolution image frame.

Claim 18 (original): The method of claim 17, wherein said high spatial frequency component generating further comprises subtracting said generated low spatial frequency component from said at least one high resolution image frame of said at least one image sequence to obtain a high spatial frequency component of said at least one high resolution image frame of said at least one image sequence.

Claim 19 (previously presented): A system for reconstructing a high resolution image from a mixed spatial resolution image sequence comprising temporally spaced-apart image frames having different respective spatial resolutions, the system comprising:

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a first frequency component generator that generates a first spatial frequency component from a first image frame selected from the image sequence, the first image frame having a first spatial resolution;

a second frequency component generator that generates a second spatial frequency component from a second image frame selected from the image sequence, the second image frame having a second spatial resolution higher than the first spatial resolution;

a remapper that spatially aligns the first and second spatial frequency components based on estimates of motion between the first and second image frames; and

a combiner that produces a high resolution image of the first image frame from a combination of the spatially aligned first and second spatial frequency components.

Claim 20 (previously presented): The system of claim 19, wherein the combiner produces the high resolution image of the first image frame from the spatially aligned first and second spatial frequency components with relative contributions controlled by measures of confidence in motion estimates used to spatially align the first and second spatial frequency components.

Claim 21 (previously presented): The system of claim 20, wherein the combiner produces the high resolution image of the first image frame with relative contributions from the second frequency component that increase with increasing measures of confidence in the associated motion estimates.

Claim 22 (previously presented): A method of reconstructing a high resolution image from a mixed spatial resolution image sequence comprising temporally spaced-apart image frames having different respective spatial resolutions, the method comprising:

generating a first spatial frequency component from a first image frame selected from the image sequence, the first image frame having a first spatial resolution;

generating a second spatial frequency component from a second image frame selected from the image sequence, the second image frame having a second spatial resolution higher than the first spatial resolution;

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spatially aligning the first and second spatial frequency components based on estimates of motion between the first and second image frames; and

producing a high resolution image of the first image frame from a combination of the spatially aligned first and second spatial frequency components.

EVIDENCE APPENDIX

There is no evidence submitted pursuant to 37 CFR §§ 1.130, 1.131, or 1.132 or any other evidence entered by the Examiner and relied upon by Appellant in the pending appeal. Therefore, no copies are required under 37 CFR § 41.37(c)(1)(ix) in the pending appeal.

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RELATED PROCEEDINGS APPENDIX

Appellant is not aware of any decisions rendered by a court or the Board that will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal. Therefore, no copies are required under 37 CFR § 41.37(c)(1)(x) in the pending appeal.